cc. Russ Hart, RPM
US EPA

United States of America v. Glen Ekberg

Civil Action No. 01C50457

United States District Court
Northern District of Illinois

EXPERT REPORT:

EFFECTS OF EARTH-MOVING ON CONTAMINATION AT THE EKBERG PROPERTY SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT ROCKFORD, ILLINOIS

prepared for the
U.S. Department of Justice
Environmental Enforcement Section
Washington, DC

by
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ii. List of Acronyms

11DCA	1,1-dichloroethane
11DCE	1,1-dichloroethene
12DCE	1,2-dichloroethene (total)
bgs	below ground surface
CDM	Camp Dresser & McKee Inc.
DNAPL	dense nonaqueous phase liquid
ERI	Environmental Research, Inc.
ft	feet
GMZ	groundwater monitoring zone
IEPA	Illinois Environmental Protection Agency
NAPL	nonaqueous phase liquid
PCE	tetrachloroethene
ppb	parts per billion
ppm	parts per million
ROD	Record of Decision
SCOU	Source Control Operable Unit
SERGWC	Southeast Rockford Groundwater Contamination Superfund Site
SVE	soil vapor extraction
TCA	1,1,1-trichloroethane
TCE	trichloroethene
USEPA	United States Environmental Protection Agency
VOC	volatile organic compounds

1. INTRODUCTION

The United States has selected Chirlin & Associates, Inc. (CAI) to provide testimony concerning aspects of contaminant distribution and migration within Source Area 7 ("Site") of the Southeast Rockford Groundwater Contamination Superfund Site ("SERGWC"), Rockford, Illinois.

In particular, the objective of the work reported here is to form and document an expert opinion on the following issue:

On March 13, 1964 Glen and Ruth Ekberg purchased 72 acres of land including Source Area 7 which already contained soil and ground-water contamination. Mr. Ekberg has since conducted earth-moving operations on this parcel. What, if any, have been the effects of these operations on the distribution and migration of contaminants and on remedial requirements and effectiveness for Source Area 7?

1.1 Identification of Expert

This report was prepared by Gary R. Chirlin, Ph.D., P.E., principal of Chirlin & Associates, Inc. His resume, testimony provided by Dr. Chirlin as an expert witness during the previous four years or more, publications from the last ten years, and compensation for this project are listed in Appendices A, B, C and D, respectively.

1.2 Information Considered

Documents and other sources of information considered in preparation of this report are listed in the Reference section of this report. I anticipate preparation of an addendum to this report when additional fact deposition transcripts and certain other Site documents are made available to me. I reserve the right to supplement and revise my opinions based on any information obtained subsequent to preparation of this report.

2. NATURAL SETTING

Source Area 7 of the SERGWC is located in Rockford, Illinois, in the southeastern corner of SERGWC, northwest of the intersection of Alpine and Sandy Hollow Road, adjacent to the eastern terminus of Balsam Lane. The boundary of Source Area 7 which I adopt is that shown on the annotated photographs of Environmental Research, Inc. ("ERI") (Jan04). Municipally owned and operated Ekberg Park lies completely within Source Area 7. The parkland originally was part of the Ekberg land parcel and was in part donated and part sold by the Ekbergs to the city in November 1985. Paved tennis and basketball courts, a children's playground, and a parking area were installed in the Park in the late 1980s – early 1990s; the remaining parkland is open grassland (USEPA 11Jun02 pg. 17; USEPA 15May03 Fig. 9; ERI Jan04). Source Area 7 extends north and south beyond the boundaries of Ekberg Park; the land outside the Park is wooded and agricultural. The Ekbergs purchased the property in 1964. Residential areas border Source Area 7 to the east and west. (USEPA & IEPA 11Jun02 pg. 17; USEPA 15May03 pg. 10; CDM 25Jul00 pg. 1-5).

Yearly average precipitation in Rockford, Illinois is 37.1 inches, with 35.3 of snowfall.

2.1 Surface Water Hydrology

Broadly, the land within Area 7 slopes downward from south to north, and surface water drains northward. Prior to Mr. Ekberg's regrading of the land surface, two small valleys existed within the steeper hillside south of the current park. These valleys merged at the base of the hill, and a single small valley channel ("main stem") continued northward through the current park. That channel fed into an unnamed, apparently intermittent creek that runs east-to-west along the northern boundary of Source Area 7 just south of the railroad bed (USEPA & IEPA 11Jun02 pg. 17; CDM 25Jul00 pg. 1-5; USEPA May03 pg. 11). The small valley network thus appeared as an inverted "Y". Water flowed intermittently within all of these channels, presumably in response to rainstorms or snowmelt.[1]

2.2 Geology

The geological setting at Source Area 7 consists of dolomite and sandstone bedrock mantled by glacial unconsolidated sedimentary deposits. These glacial deposits are a heterogeneous mix of sands, silts, and clays. The bedrock surface forms an east-west trending buried valley roughly paralleling the unnamed creek. Depth to top of bedrock varies from 35 feet ("ft") below ground surface ("bgs") on the buried valley flank to over 135 ft along the valley center. Regionally the bedrock contains vugs, fractures, and solution zones at or near its surface. (CDM 25Jul00 pp. 1-1, 3-15; CDM Jan95 pg. 3-21)

2.3 Hydrogeology

In hydrogeology the subsurface is partitioned into unsaturated zones where pores or fractures contain air as well as some water, and saturated zones where pores or

[1] Based on her review of Site aerial photography Ms. Sitton found that none of the drainages consistently contained surface water, and that the northern, east-west flowing unnamed creek was the most often water-bearing (Mary Sitton, ERI, pers. comm. 02Feb04).

fractures are completely filled with water. Typically, a single unsaturated zone extends from the surface downward and overlies a single saturated zone. At their contact, water is drawn upward by capillary effects creating a capillary fringe. The water table is defined as the level within the saturated zone at which hydraulic pressure equals atmospheric pressure, is therefore at the base of the capillary fringe, and corresponds to the level of water within a sufficiently shallow well. Ground water is defined as water within the saturated zone. An aquifer is a geologic unit (or subunit, or group of units) which will yield water in a useable quantity to a well or spring. An aquitard is a relatively lower permeability geologic unit and typically separates two aquifers.

At the Site the water table ranges from 36 ft bgs south of the park to 13 ft bgs within the park to less than two ft bgs near the unnamed creek. (These depths become shallower from south to north because of the downward slope of the land surface.) The glacial deposits and the upper bedrock constitute two hydraulically interconnected aquifers without extensive intervening aquitards. Ground-water flow in both aquifers proceeds to the northwest with localized discharge from the shallow unit to the unnamed creek. (CDM 25Jul00 pg. 3-15).

3. HAZARDOUS SUBSTANCES DISPOSAL

Waste disposal within Source Area 7 has been investigated in the field by ground-penetrating radar survey, terrain conductivity survey, and soil gas survey, all in May 1992, additional soil gas sampling in February 1993 and May-June 1996, excavation of test pits in June 1993, collection of surface soils in September 1993 and of subsurface soil borings in June-December 1993, additional surface and subsurface soil sampling in spring-summer 1996, and surface water and sediment sampling from the unnamed creek in June 1996 and December 1998 (USEPA & IEPA 11Jun02 pp. 17-26; CDM 25Jul00 pp. 1-8 to 1-10, Sects. 2.2, 2.3, 2.4, 2.5, 3.2.2; CDM Jan95 Sects. 4.4, 4.5, 4.5.1.3). In addition aerial photographic analysis has been used to characterize the timing, extent, and nature of surface disturbances—including apparent disposal activities—within Source Area 7 (CDM 25Jul00 pp. 1-5,1-8; ERI Jan04). It is my understanding that fact witness testimony during the discovery phase of this case also has provided insight into disposal activities; however, I have not yet had the opportunity to review that material.

From these data the following description has emerged of disposal and the ensuing spatial distribution of contamination within Source Area 7.

Based on aerial photos it appears that wastes were deposited on the land surface along the alignment of the Y-shaped small valley. This disposal area generally corresponds to investigation Area 7c of the Southeast Rockford Source Control Operable Unit ("SCOU") and is labeled DA-1 (and DA-1A, DA-1B) on overlays to photographs in the Site aerial photographic analysis conducted by Ms. Mary Sitton for this litigation (ERI Jan04).[2] According to that analysis disposal in this area began by 1951 and proceeded beyond May 1958 and perhaps as late as 1964.

The former Y-shaped small valley and adjacent land is the only portion of Source Area 7 in which surface and subsurface soils and soil gasses have been found to exhibit substantial VOC contamination (CDM 25Jul00 Sects. 3.2.2, 3.2.3; CDM Jan95). Contours of total VOCs and selected specific VOCs in soil and of organic vapors in soil gas reveal a zone of contamination extending approximately 100 to 150 ft on each side of the small valley (CDM 25Jul00 pp. 1-10, 3-16, Figs. 3-8, 3-12, 3-13; CDM Jan95 Sect. 4.5.1.3, Figs. 4-13 through 4-19). Three hot spots, or areas of highest subsurface contamination, have been delineated within the small valley and are targeted for remediation (USEPA & IEPA 11Jun02, pp. 19-20, 85, Fig. 3). These hot spots are indicated, and significant sampling results are described, in the Site Record of Decision ("ROD") (USEPA & IEPA 11Jun02, pp. 19-20, Figs. 3, 4)[3] and in the SCOU remedial investigation report (CDM 25Jul02 Sect. 3.2.2). The most abundant and frequently detected VOCs in the hot spots are the chlorinated hydrocarbons 1,1,1-trichloroethane ("TCA"), tetrachloroethene ("PCE"), trichloroethene ("TCE"), and 1,2-dichloroethene

[2] In this report I have relied principally on ERI (Jan04) and Ms. Sitton for aerial photographic interpretation.

[3] Although the ROD states that all three hot spots are shown in its Figure 4, in fact only the northern two are in the figure. The ROD's Figure 3, also available at USEPA (15May03, Fig. 10), shows all three of the hot spots.

(total) ("12DCE") and the non-chlorinated hydrocarbons toluene, ethylbenzene, and xylenes (CDM 25Jul00 pg. 3-16; USEPA & IEPA 11Jun02 pg. 19).

The southern hot spot is located at the former confluence of the two upstream branches of the drainage ditch. Significant total VOCs in the soils include 441 parts per million ("ppm") at station SB7-14: 4 ft bgs; 1,019 ppm at SB7-8: 15 ft bgs; and 357 ppm at SB7-9: 20 ft bgs. No tests were performed to confirm the presence of non-aqueous phase liquid ("NAPL")[4] waste in the southern hot spot, but the observed concentrations and odors suggest its presence (USEPA & IEPA 11Jun02 pg. 20). (USEPA & IEPA 11Jun02 pp. 19-22; CDM 25Jul00 pp. 3-16, 3-22).

The central hot spot is within Ekberg Park immediately west of the tennis court. Here notable total VOC concentrations in soils have been found approximately 19 to 23 ft bgs including 35 ppm at SB7-4: 20 ft bgs. (USEPA & IEPA 11Jun02 pp. 19-22; CDM 25Jul00 pp. 3-16, 3-22).

The northern hot spot encompasses land north and west of the park playground straddling the northern Ekberg Park boundary.[5] Significant total VOCs concentrations have been detected from 3 ft bgs to at least 28 ft bgs. Notable results for total VOCs include 627 ppm at SB-24: 4 ft bgs; 17 ppm at SB7-202: 11 ft bgs; and 875 ppm at SB7-201: 25 ft bgs. In boring SB7-201: 25-27 ft bgs NAPL was visually observed and confirmed by a Sudan IV dye shaker test. (USEPA & IEPA 11Jun02 pp. 19-22; CDM 25Jul00 pp. 3-16, 3-22).

A composite contour diagram of total VOCs within Site subsurface soils based on data current through the SCOU is available at CDM (25Jul00 Fig. 3-12). The three hot spots are aligned along the former drainage channel. Significant concentrations of VOCs also are inferred along the channel between the hot spots.

In general, the contaminated soil depth interval extends from the surface to approximately 40-45 ft bgs (CDM Jan95 pg. 4-57, Fig. 4-13). Peak concentrations of wastes are encountered within 25 ft of the surface and are consistently located in the upper portion of the saturated zone or just above the saturated zone (CDM Jan95 pg. 4-57). In some locations substantial contamination is nearer to the surface. For instance high contamination is present as shallow as 5 ft bgs at SB7-10 located within the V of the Y, and surface soil contamination also is particularly elevated at this location (CDM Jan95 pp. 4-32).

The vertical distribution of subsurface contamination appears largely insensitive to changes in the stratigraphy. High concentrations are found in both silty and sandy units. Contamination has penetrated into low-permeability strata such as sandy silts and clayey silts. (For instance, the middle portions of five-foot thick clayey silts at stations S7-9 and SB7-21 have very high VOCs concentrations.) (CDM Jan95 pg. 4-59).

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[4] NAPL, pure product or waste undiluted by water, acts as a reservoir of contamination that gradually leaches into passing ground waters. It is of course extremely concentrated, and typically it is persistent in the subsurface and difficult to locate and remediate.

[5] The northern boundary of Ekberg Park lies approximately midway between the two highly contaminated soil sampling stations SB7-201 and SB7-202 (CDM 25Jul00 pg. 3-16, Fig. 3-10).

Close to the surface the most volatile compounds (TCA, TCE) are expected to be relatively depleted and less volatile compounds to be relatively enriched (PCE, semivolatiles) (CDM Jan95 pg. 4-33). Although the mix therefore changes somewhat, total VOCs concentrations remain mild to moderate in the shallowest samples of DA-1 (Area 7c) (CDM Jan95 pg. 4-33). Seven surface soil samples were collected 6-12 inches bgs during September 1993. Analyses detected 12DCE up to 220 parts per billion ("ppb"),[6] TCA up to 40 ppb, TCE up to 140 ppb, PCE up to 400 ppb, and lesser levels of 1,1-dichloroethane ("11DCA"), 1,2-dichloroethane, and toluene (USEPA & IEPA 11Jun02 pg. 19; CDM Jan95 Sect. 4.4). Two more recent surface soil samples (0-6 inches bgs) collected from the grassy areas of Ekberg Park in June 1996 also contained VOCs. Sample SS7-102 located about 150 ft west-northwest of the tennis courts contained 5 ppb TCA, and sample SS7-104 located about 280 ft northeast of the tennis courts contained 1 ppb toluene (CDM 25Jul00 pg. 3-22, Fig. 3-11). SS7-102 is within the area of highly contaminated subsurface soils (e.g., CDM 25Jul00 Fig. 3-12).

Near-surface contamination within DA-1 (Area 7c) also has been characterized using two test pits excavated and sampled in June 1993. Test Pit #1 ("TP-1") was in the southeast leg of the small drainage valley in an area of geophysical anomalies and Test Pit #2 ("TP-2") was in the main stem small drainage channel approximately 125 ft south of the basketball court in an area of geophysical and soil gas anomalies (CDM Jan95 Sect. 4.3, Fig. 4-9). Two of the four preliminary soil borings at TP-2, sampled continuously with 2-ft long split spoons from 1 ft to 15 ft bgs, detected organic vapors in every sample. This indicates that contamination was present at TP-2 from at least 1 ft bgs to 15 ft bgs (CDM Jan95 Table 2-2). Test pits were 10 ft by 10 ft planview and 15 ft deep. Excavation revealed metal cans, other metal objects, glass bottles and miscellaneous trash. At TP-1 the subsurface soil was a moist brown silt and sand; at TP-2 the subsurface soil was brown sand and moist, gray-stained odoriferous sand. Four soil samples were collected from each pit. One of the four samples from TP-1 contained detectable contamination: 500 ppb PCE at 4 ft bgs. All four samples from TP-2 were contaminated. Sample TP2-SS3 collected approximately 6 ft bgs contained 22,000 ppb PCE, 4,000 ppb TCA and 3,000 ppb TCE. Concentrations of 1,000 to 3,000 ppb of PCE, 12DCE, TCA and xylenes were present in one to two of the other three samples in TP-2 (TP2-SS4 approximately 10 ft bgs and TP2-SS6 approximately 7 ft bgs).[7] Two additional soil samples were collected at each pit for TCLP organics analysis.[8] TP-1 contained detectable toluene in both samples (24 ppb in TP1-SS1 at 4 ft bgs, 32 ppb in TP1-SS2 at 9 ft bgs). TP-2 contained multiple organics including TCA (1,300 ppb in TP2-SS1 at 15 ft bgs), TCE (1100 ppb in TP2-SS1, 44 ppb in TP2-SS2 at 10 ft bgs), PCE (3,200 ppb in TP2-SS1, toluene (260 ppb at TP2-SS1), and 1,2-dichlorobenzene (56 ppb at TP2-SS1). Eleven air samples were collected from the breathing zone around the two test pits. The results are consistent with the soil sampling results. Air downwind of TP-1 exhibited contamination at low levels of 12DCE, TCA, TCE, and PCE. Air downwind of TP-2 contained considerably higher concentrations of PCE, TCA and TCE. (USEPA & IEPA 11Jun02 pg. 18; CDM Jan95 Sects. 2.4, 4.3).

[6] A ppb is one one-thousandth of a ppm. In Site literature, and here as well, total VOC concentrations generally are reported in ppm but individual compounds (such as TCA) may be in either unit. Herein I have consistently used ppb.

[7] I await arrival of CDM (Jan1995, Appendix H) to determine the sampling depth of TP2-SS5.

[8] The Toxicity Characteristic Leaching Procedure ("TCLP") passes acidified water through a soil or waste sample and analyses the resulting leachate.

In summary, soil VOCs contamination within portions of DA-1 (Area 7c) occurs throughout the vertical profile from the surface to as much as 45 ft bgs, as determined from surface soil, subsurface soil, and test pit sampling.

Three additional disposal areas (other than DA-1 / 7c) have been identified by aerial photo interpretation.

Disposal area DA-2 in the northeast corner of the Ekberg property appears in 1956 through 1964 aerial photos. Debris, mounding and access roads clearly indicate use of the area as dumping site (M. Sitton, pers. comm. 02Feb04). After 1964 the land surface is graded; aerial photos do not reveal whether the deposited materials were removed or buried, but they are no longer visible[9] (M. Sitton, pers. comm. 02Feb04). To my knowledge this area has not been sampled or otherwise characterized by Site investigations.

Disposal area DA-3 is located southwest of DA-2 directly north of O'Connell Street and generally corresponds to investigation Area 7a of the SCOU (CDM 25Jul00 Fig. 1-4). This area first appears as an excavation with liquid in 1970 and as a disposal area in 1976. It is most extensive in a 1980 photo, is revegetated in 1987, and consists of isolated light mounded material in subsequent years. (ERI Jan04). No significant soil gas or geophysical anomalies were detected in this area (Area 7a) during the Site Phase II RI (CDM 25Jul00 pg. 1-10), and no further sampling has been conducted.

Disposal area DA-4 first appears in 1978 and 1979 aerial photos within the western portion of an extensive sand pit. This quarry, located immediately east of DA-1, is present in earlier and later years as well and generally corresponds to investigation Area 7b of the SCOU (CDM 25Jul00 Fig. 1-4). In these two photos debris and probable debris prompted characterization of DA-4 as a disposal area. The 1978 photograph is highly resolved, allowing the analyst to distinguish between waste vegetation such as tree limbs versus more angular waste debris. The 1980 photograph is of lower resolution; debris may or may not have been present at that time. By 1988 DA-4 has been backfilled and graded; aerial photographs do not indicate whether the wastes were removed or buried, but they are no longer visible (previous four sentences: M. Sitton, pers. comm. 02Feb04). No significant soil gas or geophysical anomalies were detected in this area (Area 7b) during the Site Phase II RI (CDM 25Jul00 pg. 1-10), and no further sampling has been conducted.

Wastes disposed of within Source Area 7 have contaminated the underlying ground water. Two downgradient monitoring wells have exhibited very high concentrations of TCA (MW135: 8,000 ppb; MW106A: 7,900 ppb); other detected VOCs include PCE, TCE, 12DCE, vinyl chloride, and ethylbenzene (USEPA & IEPA 11Jun02 pg. 22).

[9] Aerial photos do not always reveal surface debris. A hedge grove/trash pit or trash/brushy area reported by inspectors in March 30, 1992 (ecology & environment 10Apr92) was not evident in the March 19, 1991 photo (ERI Jan04). Reported wastes on the land surface in March 1992 included municipal waste such as household appliances and glass, medical waste such as syringes, and assorted rusted drums and paint cans) (CDM 25Jul00 pg. 1-8).

The small valley drainage channel through the current park and the unnamed creek north of Source Area 7 also are contaminated with the same chlorinated VOC compounds present in Source Area 7 as well as with common degradation products of those compounds. One sample pair of water (S202) and sediment (X102) was collected from the main stem small valley channel in the northern hot spot area. This location appears to characterize contamination migrating from Source Area 7c towards the unnamed creek. One or both of those samples were found to be contaminated with TCA,[10] 11DCA, 1,1-dichloroethene ("11DCE"), 12DCE, chloroethane, vinyl chloride, TCE, chloroform, and xylenes (USEPA & IEPA 11Jun02 pg. 23, Tables 3, 4, Fig. 4). Samples along the unnamed creek upstream of its confluence with the small valley drainage channel also have contained most of these chemicals, so additional, unidentified sources appear to be contributing to the creek degradation. Design phase sampling will further explore this issue (USEPA & IEPA 11Jun02 pg. 46).[11]

[10] The SCOU ROD Table 4 does not include TCA results for the surface water samples; I have requested the data.

[11] One candidate for upstream source is the unsampled disposal area DA-2.

4. EARTH-MOVING OPERATIONS

During Ekberg ownership of Source Area 7 (March 1964 to present) much of the property including contaminated land (DA-1 / Area 7c) was graded and cleared as of the April 1986 and April 1988 photos (ERI Jan04, pg. 11). During this process former surface wastes were either buried, removed, or moved to a location not visible in the aerial photos. A portion of DA-1 was not completely cleared of trash by 1988: a March 1992 inspection by USEPA encountered an area of brush/trash, or a trash pit (ecology & environment 10Apr92).

Excavation into disposal areas is of particular interest (Section 5), and there is evidence of such activities within part of DA-1. The southeast portion of an excavation (annotated EX/CA) first visible in a July 5, 1970 photo—and not in the preceding May 21, 1964 photo—cut into an area that contained multi-toned mounded material and debris in 1956 (ERI Jan04 pg. 8; M. Sitton pers. comm. 02Feb04). Excavated areas and probable equipment also are visible in that vicinity in 1970, and the deepest excavations are approximately 12 ft deep (ERI Jan04 pg. 8; M. Sitton pers. comm. 02Feb04). The area subsequently was filled and graded between 1976 and 1986 (M. Sitton pers. comm. 10Feb04). From these observations I infer that the Ekberg earth-moving activities likely included disturbing, excavating, and moving some wastes and waste-contaminated soils

Earth-moving during Ekberg ownership of Source Area 7 also filled in existing drainage channels and created or induced formation of new ones within DA-1. CDM inferred from its study of aerial photography that the drainage valley west of playground was about 50-60 ft further west prior to about 1988 (CDM 25Jul00 pg. 3-29). New drainage channels appeared within and near to Ekberg Park in the 1990s, apparently as a consequence of topographic alterations related to park construction (ERI Jan04 pp. 4, 12).

It is my understanding that additional information on Site disposal and on earth-moving operations is available in deposition testimony taken for this litigation. I have not yet had the opportunity to review those documents.

5. IMPACTS OF EARTH-MOVING OPERATIONS

The United States is interested in any impacts of earth-moving operations at the Ekberg property on the contaminant distribution or on the remedy in Source Area 7. Conceptually, earth-moving operations could have impacted the contaminant distribution or remedy

(1) by directly moving contaminated material,
(2) by disturbing containers of waste and thus exposing or spilling their contents,
(3) by burying waste which was previously at the surface, or
(4) by altering overlying soil cover in a way which changes the fate of pre-existing contaminated material.

The Site contaminant distribution has been discussed in Section 3. In Section 5.1 I describe the planned remedy for Source Area 7. In sections 5.2 through 5.5 I discuss each of the above four potential mechanisms with respect to the Ekberg property.

5.1 Source Area 7 Selected Remedy

The selected remedy for Source Area 7 consists broadly of two elements: soil contaminant/NAPL removal and leachate[12] control. Soil contaminant/NAPL removal will be accomplished by soil vapor extraction ("SVE")[13] in the unsaturated zone and by air sparging[14] and multi-phase extraction[15] in the saturated zone. Leachate control will be provided by ground-water extraction within the designated Groundwater Monitoring Zone ("GMZ")[16] *and supported by ground-water monitoring.* (IEPA and USEPA 11Jun02 pp. 63, 64, SCS-7E, SCL-7B).

[12] At this Superfund site the term "leachate" apparently is freighted with legal significance (US4680, Comment 16). Leachate is defined here by IEPA to mean "source material that has moved, or could potentially move, from a source area into groundwater in the vicinity of the four primary source areas. Leachate consists of a high concentration of contaminants that have leached from the source material into the surrounding groundwater. It is distinct from the surrounding groundwater due to those relatively high concentration and acts as a continuing source of contamination to the surrounding, less contaminated groundwater (IEPA May 2002 pg. 8).

[13] SVE uses vacuum pumps attached to wells to extract vapor-laden soil gas from the unsaturated subsurface, thus inducing further vaporization and capture of liquid and sorbed soil contamination.

[14] Air sparging injects air through wells into the saturated subsurface to induce vaporization of dissolved and sorbed volatile compounds. The gasses rise above the water table where they are drawn into SVE wells.

[15] Multi-phase extraction draws a combination of NAPLs, leachate (ground water), and soil vapor into a wellbore (USEPA & IEPA 11Jun02 pg. 85).

[16] Under state groundwater regulations at 35 Ill. Adm. Code Section 620.450, a GMZ is defined as the volume containing groundwater being managed, mitigating impairment caused by contamination. The GMZ boundary becomes a perimeter around a site outside of which groundwater must meet state standards. Although typically the standards are those of Class 1 groundwater, at SERGWC the widespread contamination from multiple sources precludes this approach: the GMZ would be too big and untargeted to have practical value. The GMZ for Area 7 has been set to enclose areas of contaminated soil and where it was deemed possible for proposed remedial action to achieve ARARs. (USEPA & IEPA 11Jun02 pp. 49, 82).

5.2 Moving Contaminated Material

This section examines whether earth-moving activities at the Site involved transport of either wastes or soils contaminated by waste constituents, and implications to contaminant distribution and remedy.

In general, moving a load of contaminated materials from place to place can aid, impair, or not significantly affect the environment or remedy depending on factors such as earth-moving source and destination locations, chemical composition of the moved materials, pre-existing contamination at the destination location, contamination remaining at the source location, differences in soil and hydrogeologic properties at the source and destination locations, and precautions taken to prevent or mitigate impacts. Such details are rarely known for historical activities; at the Site no such information has been developed. In the absence of Site-specific information one can say only that where waste or contaminated soils were moved by the Ekberg operations, then the following impacts may have occurred:

(1) The area of contaminated land was enlarged. This may have engendered additional investigation (more samples to define the limits of contamination) as well as an areally and volumetrically more extensive and less efficient remedy (e.g., more wells extracting or monitoring lower contaminant concentrations).
(2) Ground-water contamination was exacerbated. When a source area is enlarged, then the area, volume, and/or concentration of an underlying contaminated ground water plume may be increased.
(3) The remedial investigation was made less reliable. Dispersion of contamination to multiple non-contiguous locations makes it more likely that some will be overlooked during investigation. Contamination may have been moved to locations which do not correspond to dumping areas evident from aerial photographs and therefore were not explored by the Site soil gas and geophysical surveys.[17]
(4) The remedy was made less effective. Contaminated soil may have been moved out of the three hot spots where targeted treatment is planned, and into diffuse lower-concentration source areas (such as exist between the hot spots) which are not planned for soil/NAPL treatment but likely do have some impact on the ground water.

If contaminated materials were moved then some or all of the four foregoing impacts likely were incurred. No samples were collected of soils as they were being moved by Mr. Ekberg. However, as described in Section 4 it is known that by 1970 an excavation proceeded into at least one former (1956) disposal area along western DA-1 which was subsequently filled and graded. Soil sampling conducted in 1993 establishes that soils in this formerly excavated area are substantially contaminated with VOCs.[18] This implies

[17] The soil gas and geophysical surveys were conducted on a 50-ft grid across the three suspect areas (7a, 7b, and 7c) identified from aerial photographs and surface debris (CDM 25Jul00 pp. 1-8, 1-10, Fig. 1-4).
[18] Two soil borings were drilled and sampled within that excavated area: SB-8 and SB-22. In the vicinity of these samples the 1970 photo indicates an excavation depth of 4 – 6 ft bgs. (CDM Jan95 Fig. 4-15; ERI Jan04, 05Jul70 photo; M. Sitton pers. comm. 10Feb04). The area has since been backfilled and graded (M. Sitton pers. comm. 10Feb04). The 1993 boring logs encountered topsoil from the surface to 5.5 ft and 5.3 ft bgs in the two borings; the boring logs for SB7-8 and SB7-22 do not mention whether the topsoil appeared to be fill. Both borings contained VOCs in

that Mr. Ekberg's excavation and fill in this area involved movement, disturbance, and cover of substantially contaminated materials. Therefore in this area it is likely that some or all of the four foregoing impacts likely were incurred.

As also described in Section 4, during Ekberg ownership of Source Area 7 much of the property including contaminated land (now DA-1) was graded and visible debris was removed, buried, or moved to areas not visible to aerial photos. As described in Section 3, surface soils and shallow subsurface soils have been found to be contaminated by VOCs at locations within DA-1. Therefore it is plausible that Mr. Ekberg moved contaminated materials in addition to those described in the previous paragraph. If contaminated materials were moved then some or all of the four foregoing impacts likely were incurred.

The detection of site contaminants in soil samples within an area altered by Mr. Ekberg's earth-moving operations is significant. It is my understanding that releases at the Site have been distributed spatially but occurred at or very near to the surface. Therefore the presence of contamination in a soil sample where cut and fill or just fill have occurred reflects one of three conditions: (1) contamination was imported with the fill and therefore contaminated soil was moved, or (2) contamination was sampled from below the excavation depth in which case some overlying contaminated soil almost surely was removed and placed elsewhere, or (3) contamination has migrated to this soil (say, by sorption of soil gas vapors rising from below, or by deposition of contaminated sediment during storm runoff) in which case clean soils placed in this area have become contaminated. All three of these alternatives represent spreading of contamination, either to clean soils or to different locations.

It is plausible that additional excavation of wastes occurred. The Ekberg surface grading involved both cut and fill, and therefore some portions of the landscape were excavated. A net result of the Ekberg grading operations has been leveling of the land surface along the drainage channels. Other than the cited example of the EX/CA area, I know of no evidence of excavation inside the historical (pre-March 1964) contaminated disposal area—in other words along the original Y-shaped small valley (DA-1, DA-1A, DA-1B of ERI Jan04). It is possible that the contaminated small valley has been leveled solely by filling with soils obtained from outside the contaminated zone. On the other hand it is possible that additional excavation was performed within the small valley, perhaps in order to consolidate wastes or debris into the channels, with concomitant movement of contaminated material.

1993. Organic vapors (field-tested head space over soil samples collected at 5-ft intervals) indicated contamination at every tested depth (0 ft to 45 ft bgs at SB7-8 and 5 ft to 20 ft bgs at SB7-22); however, contamination was low in the three samples collected at 0 ft or 5 ft bgs. Organic vapor concentration peaked at 15 to 20 ft bgs. (CDM Jan95 Fig. 4-13). The 15 ft bgs soil sample at SB7-8 was selected for chemical analysis and proved to be the most contaminated RI Phase II sample in Source Area 7 for several compounds, including TCA (380,000 ppb), TCE (130,000 ppb), PCE (260,000 ppb), toluene (23,000 ppb), and ethylbenzene (31,000 ppb) (CDM Jan95 Table 4-3). SB7-22 also was substantially contaminated; the analyzed sample (15 ft bgs) contained 10,000 ppb 12DCE, 30,000 ppb TCA, 960 ppb TCE, 8,800 ppb PCE, 1,500 ppb toluene, 4,400 ppb ethylbenzene, and 19,000 ppb xylenes (CDM Jan95 App. H-4).

In addition to soil transfers in the bucket of earth moving equipment, soil and any sorbed contaminants likely also migrated on the caterpillar treads (if any) or tires of heavy equipment. A noticeable amount of material can be tracked from one place to another by earth-moving equipment. (Anyone living along a road next to a quarry will confirm this.) In the present context this transport mechanism is significant because it carried soils in both directions: into contaminated area DA-1 and out of contaminated area DA-1. Thus it is likely that some contaminated soils were eroded and carried about by the treads or tires and that clean soils were brought into contaminated areas and subsequently became contaminated.

5.3 Exposing or Disturbing Buried Waste

This section examines whether earth-moving activities at the Site exposed or otherwise disturbed wastes, and implications to environmental impact and remedy.

In general, earth-moving may disturb buried wastes or waste containers and
(1) expose previously buried wastes to the surface, thus changing the fate and transport of the wastes;
(2) increase the surface area of buried compacted wastes by dispersing them, thus increasing rate and/or concentration of dissolution into infiltrating precipitation and exacerbating soil and ground-water contamination;
(3) mobilize wastes from manmade or natural (e.g., a clay lens) containment, thus increasing rate of release to the soils and ground water;
(4) alter the effectiveness of the remedy (for better or worse).

If the Ekberg earth-moving operations exposed or disturbed buried wastes, then it is likely that some or all of the foregoing impacts were incurred. I am not aware of any specific information describing the disturbance of buried wastes, waste containers, or other debris during the Ekberg excavation and regrading operations, nor of the nature of manmade waste containers, if any. However, the ca. 1970 excavation into a contaminated former disposal area within DA-1 (Section 5.2) may have encountered, exposed, and disturbed buried wastes.

5.4 Burying Surficial Wastes

This section examines whether earth-moving activities buried Site wastes, and implications to environmental impact and remedy.

In general, earth moving may bury surficial wastes. Waste burial can greatly complicate and compromise remedial efforts. It is much easier, cheaper, and more effective to collect wastes on the surface than to recover waste constituents dispersed into the soil, soil gas, and/or ground water. If wastes were buried by the Ekberg earth-moving operations then such dispersal likely occurred.

It is possible that waste burial occurred at the Site during the period of Ekberg ownership. Aerial photos indicate formerly debris-strewn areas that were graded over during Ekberg ownership and no longer exhibit visible debris (ERI Jan04). These wastes were buried, removed, or perhaps still are on the surface but have been moved to an area not visible in aerial photos.

5.5 Altering the Soil Cover

This section examines whether earth-moving activities changed the soil cover, topography, and drainage within contaminated areas, and implications to environmental impact and remedy.

As described in Section 4, reworking of the land within Source Area 7 has modified the topography and has altered the course of drainage channels. In general by changing the land surface cover and topography, earth-moving operations at the Site can have the following impacts on contamination and remedy.

(1) The rate and spatial distribution of infiltration of precipitation is changed. Infiltration often concentrates along drainage channels due to greater head (surface water depth) and longer duration of wet conditions. When these corridors of enhanced infiltration are shifted, different buried wastes and contaminated soils are preferentially leached, causing changes in contaminant migration and changes in contaminant loading to the ground water. This can make the remedial investigation more difficult and a remedy more extensive or less effective.

(2) More globally, reworking of soil typically increases infiltration rate and therefore leads to increased leaching of underlying wastes and contaminated soils to the ground water.

(3) Where the surface drainage waters carry dissolved contamination, a shift in drainage channel location leads to infiltration of dissolved contaminants along a new route.

(4) Where surface drainage waters carry contaminated suspended or bedload particulates, a shift in drainage channel location can lead to deposition of contaminated sediments along a new channel bed. The rerouted channel also can erode downward and encounter and redistribute previously buried sources of contamination. By dispersing contamination, these effects can make remedial investigation more difficult and a remedy more extensive or less effective. They also can change the contaminant mass or concentration discharged to downstream surface water bodies.

(5) Where soil cover is added increasing the thickness of the unsaturated zone, the rates of vaporization of underlying volatile wastes may be reduced and the rates of biodegradation that rely on gas exchange with the atmosphere may be reduced. Both of these effects can increase the duration of a remedy.

Even the shifting of a drainage channel away from an area of contamination may have an undesirable effect. For instance, the most contaminated soil samples within Source Area 7 were obtained from station SB7-201 located beneath the former south-north drainage channel. As mentioned, the channel now is 50 to 60 ft east of SB7-201 due to post-1988 Ekberg earth-moving operations (CDM 25Jul00 pg. 3-29). It is likely that as a result of the channel shift, less leachate now emanates from the contaminated soils. That leachate may be more concentrated than formerly (if desorption was rate-limited) and the remedy may now take longer than otherwise (because more mass remains within the source).

6. REFERENCES

6.1 Site-Specific

US Environmental Protection Agency (Aug89). Site Analysis, Southeast Rockford, Rockford, Illinois, Volume 1 (text). ORD, Environmental Monitoring Systems Laboratory, Las Vegas NV. TS-PIC-89028. Text without photos or overlays. Bates # US00590-629.

ecology & environment (10Apr92). Memo from Steven J. Skare, E&E TAT to Ken Theisen, USEPA re: Southeast Rockford, Rockford, Winnebago County, Illinois, RDD #: T05-9203-018, PAN #: EIL0745VBA. Bates # US00891-897.

US Environmental Protection Agency (Aug92). Site Analysis, Southeast Rockford, Part 2, Rockford, Illinois, Volume 1 (text) and the odd-numbered photos and overlays from Volume 2. ORD, Environmental Monitoring Systems Laboratory, Las Vegas NV. TS-PIC-92069. Bates # US00631-671 (text).

CDM (Jan95). Remedial Investigation Report, Southeast Rockford Groundwater Contamination Study. Volume 1, Bates # US01970-2369.

CDM (Jan95). Remedial Investigation Report, Southeast Rockford Groundwater Contamination Study. Appendices Volume 1, App. A, boring logs for SB07-8 and SB07-22 only; Volume 2, Appendix H only.

CDM (25Jul00). Final Remedial Investigation Report for the Southeast Rockford Source Control Operable Unit. Two volumes. Excerpts only, including Sections 1, 2, 3.1, 3.2 and Appendices A, C, and F.

Illinois Environmental Protection Agency (May02). Responsiveness Summary, Source Control Feasibility Study and Proposed Plan, Southeast Rockford Groundwater Contamination Superfund Site. Bates # US4669-4704.

Illinois Environmental Protection Agency and US Environmental Protection Agency (May02). Offices of Community Relations and Community Involvement. Record of Decision, Source Control Remedies, Southeast Rockford Groundwater Contamination Superfund Site. Bates # US4662-4665.

Illinois Environmental Protection Agency and US Environmental Protection Agency (11Jun02). Southeast Rockford Groundwater Contamination Superfund Site, Rockford, Illinois, Declaration for the Record of Decision. Bates # US4705-4858.

Illinois Environmental Protection Agency and US Environmental Protection Agency (20Jun02). Third and Final Remedy Decision Announced for Southeast Rockford Groundwater Contamination Superfund Site. Bates # US4666-4668.

US Environmental Protection Agency (15May03). Second Five-Year Review Report for Southeast Rockford Groundwater Contamination Site, Rockford, Illinois.

Environmental Research, Inc. (Jan04). Aerial Photographic Site Analysis, Source Area 7 of the Southeast Rockford Groundwater Contamination Superfund Site, Rockford, IL.

Undated unlabeled oversize infrared aerial photo of Area 7.

Environmental Research, Inc. (undated). B&W copy of two 11x17 figures consisting of a portion of figure 4-15 from CDM (1994) Remedial Investigation Report (Bates # US2103) overlaid on aerial photos of Site 7 from April 1986 and April 5, 1998.

Environmental Research, Inc. (undated). Copies of four CDM figures on acetate, scaled to match ERI (Jan04) photos.

6.2 General

Westlaw (29Jan04). Alcan-Toyo America, Inc., Plaintiff, v. Northern Illinois Gas Company and Commonwealth Edison Company, Defendants. 881 F. Supp. 342. Fax from Mary Reed, USDOJ, 29Jan04.

APPENDIX A: Resume of Gary R. Chirlin

Chirlin & Associates, Inc. *Rockville, MD 20855*
301-963-6000

GARY R. CHIRLIN

PROFESSIONAL HISTORY

Chirlin & Associates, Inc., President, 1986 to present
Woodward-Clyde Consultants, Inc., Senior Project Engineer, 1984 to 1986
S.S. Papadopulos & Associates, Inc., Hydrologist, 1982-1984
R.W. Cleary, Consulting Hydrogeology, Hydrologist, 1977-1978 (part-time)
Smithsonian Institution, Chesapeake Bay Center for Environmental Studies,
Research Hydrologist, 1974-1977

EDUCATION

Ph.D. 1982 (Civil Engineering, Water Resources) Princeton University
S.M. 1974 (Civil Engineering, Water Resources)
Massachusetts Institute of Technology
S.B. 1972 (Earth and Planetary Sciences II)
Massachusetts Institute of Technology

REGISTRATION AND AFFILIATIONS

Registered Professional Engineer (MD #13971)
American Geophysical Union, Hydrology Section
National Ground Water Association,
Association of Groundwater Scientists and Engineers
Technical reviewer: Water Resources Research, J. of
Hydrology; ASCE J. Hydraulics Div.
State Water Quality Advisory Committee (Maryland), retired

TECHNICAL SPECIALTIES

Quantitative methods in ground-water hydrology;
contaminant fate and transport in ground water;
statistical analysis; project management;
expert testimony

Gary R. Chirlin

DESCRIPTION OF ACCOMPLISHMENTS

Dr. Chirlin is a civil engineer and hydrologist specializing in the design and analysis of ground water supplies, ground-water contaminant transport, and ground water remedial systems, and in the hydrogeologic aspects of landfill siting and design.

Dr. Chirlin trained in surface- and ground-water hydrology, aquatic chemistry, geology, applied mathematics, statistics, stochastic processes (e.g., kriging), systems analysis, and computer sciences. This mix of subjects has proven to be critical in the analysis of surface-water and ground-water processes.

At the Smithsonian Institution's Chesapeake Bay Center for Environmental Studies, Gary played two roles. As a research hydrologist with Dr. David Correll he studied the relationship between watershed land use ("nonpoint sources") and the water quality of the Rhode River estuary. In addition he designed, installed, and supervised the first onsite computer facility to serve the research staff of CBCES.

After receiving his Ph.D. Gary entered consulting, serving in increasingly responsible technical capacities at two nationally respected firms. He provided mathematical and computer modeling of ground water flow and contaminant transport, design and analysis of aquifer tests, interpretation of hydraulic and water quality field data, design of ground-water remediation facilities, critical technical review, staff training, and project management. At Woodward-Clyde Consultants he was utilized as a "regional resource": for major projects he provided in-house consulting services to Woodward-Clyde offices throughout the eastern and central US.

In 1986 Dr. Chirlin established his own firm. Through CAI he has since served a broad spectrum of clients, from basic research foundations to government/industrial/commercial entities to citizens' groups. His work is very thorough and meticulous in a field where attention to detail often makes the difference between success and failure. He writes and speaks often and well, and recognizes the prevailing importance of communication.

REFERENCES

Upon request.

Gary R. Chirlin

REPRESENTATIVE PROJECT EXPERIENCE

Ground-Water Quality

Citizens' Watch for a Clean Environment, Chemtronics Superfund site, Swannanoa NC:
Technical Advisor under TAG. Review and comment on technical documents concerning CERCLA site contaminated by ordinance manufacturing wastes, conduct public informational meetings, and serve as an advocate to EPA on scientific matters.

US Dept. of Justice, Environmental Enforcement Section, Expert Witness, Moyer Municipal Landfill, Collegeville, PA:
Evaluation of extent and nature of site leachate and ground-water contamination. Establishment of appropriate site background concentrations for naturally occurring substances in soils and ground waters. Extensive review of sampling documentation leading to discovery of switched sample results.

US Dept. of Justice, Environmental Enforcement Section, Expert Witness, Aerojet General Corp. site, CA:
Evaluation of present and potential rate of TCE migration in ground water to the American River upstream of major public water supplies for Sacramento, CA; in support of CERCLA consent decree negotiations.

US Department of Justice, Environmental Enforcement Section, Expert Witness, Conrail Elkhart Railyard site, IN:
Determination of origin, extent, and rate of migration of a CCl_4 plume and a TCE plume at the railyard. Geologic data interpretation using domestic well logs, revealing a large body of clay and thus explaining observed contaminant distribution and flow directions and invalidating other experts' opinions. Critical assessment of lead-stem auger (LSA) sampling protocols, thus explaining "inconsistent" spatial patterns of CCl_4 contamination and resolving the onsite origin and limits of that plume.

US Department of Justice, Environmental Enforcement Section, Expert Witness, Borden Chemicals Corp., Geismar, LA:
Evaluation of the horizontal and vertical extent of DNAPL (especially 12DCA) and dissolved solvents at a large chemical production facility with numerous unlined disposal ponds and channels. Site is underlain by silts and fractured clays. Interpretation of cone penetrometer test (CPT) sampling data and critical assessments of 3D kriging and of a proposed hydraulic containment system.

US Department of Justice, Environmental Enforcement Section, Expert Witness, Aberdeen Pesticide Dumps, NC:
Determination of hazardous substances released at two disposal areas, extent of migration of these substances in ground water, and divisibility of harm between the sources.

Gary R. Chirlin

IBM Corp. Solvent Spills, Manassas, VA:
Hydrologic Investigation to design Remedial Investigation Work Plan for PCE contamination in fractured rock. Technical review of prior investigations. Design of pump tests. Supervision of community well survey program. Work proceeded formally under RCRA but also satisfied CERCLA guidelines and formats.

Citizens' Recycling Advisory Board and NYC Department of Sanitation, Fresh Kills Landfill, Staten Island NY:
Technical Review of site investigation and remedial planning for New York City's landfill. The landfill is leaking leachate into the Arthur Kill and tributaries, and into neighboring aquifers.

Panasote Rubber Bonding Plant, VA, Solvents Contamination:
Analysis of ground water flow and contaminant discharge from used-solvents and off-spec parts disposal areas toward adjacent properties and river; in anticipation of property transfer.

Allied Chemical Corp., Baltimore, MD, Chrome Tailings Landfill:
Assessment of chrome leachate distribution, ground-water flow, and potential leachate migration, in support of RCRA Part B permit application.

AT&T, Inc., Kearny NJ Works, Solvent Spill:
Design, supervision, and interpretation of field investigation at retired wire manufacturing facility with volatile organic compounds in the ground water. Conceptual design of remedial ground water extraction/recharge system.

IT Corp., Livingston, LA Train Derailment:
Substantive review and revision of statistically-based analytical mass transport model to predict migration of PCE from the derailment site. Technical lead in multidisciplinary planning meetings. A RCRA site.

Diamond Shamrock Corp., Newark NJ Plant Decommissioning:
Analysis of alternative remedial designs for site contaminated by dioxin and multiple organic and heavy metal compounds. Slurry wall hydraulics under tidal influence; dewatering during excavation.

Legal Counsel for IBM Corp., Kansas City, KS, Conservation Chemical Corp. Landfill: Analysis of hydrogeological aspects of CERCLA site assessment and remedial design for site contaminated by multiple organic and inorganic compounds. Aquifer tests, natural ground-water flow and slurry wall containment dynamics in the Missouri River floodplain; contaminant flux estimates; technical reviews in support of litigation; expert witness testimony.

Gary R. Chirlin

Legal Counsel for Purex Corp., Garden City, NY, Solvent Transfer Facility:
Analysis of complex hydrogeological setting and movement of volatile organic solvents in the ground water, using a three-dimensional numerical model. Review of remedial plans; support in settlement negotiations.

Battelle, Office of Crystalline Repository Development:
Guidance and review of screening model development for candidate sites of a high-level waste repository in crystalline rock.

Amoco Oil Company, Independence, MO, Refinery Decommissioning:
Study design, supervision, and data analysis for Refinery-Wide Hydrology and Groundwater Investigation. Multiple RCRA waste management units onsite required assessment, closure.

Legal Counsel for Ryan, Elliott and Company, Inc., Real Estate, Boston, MA, Site Assessment prior to Refinancing:
Inspection and field investigation of multi-use commercial/industrial rental property to assess possible environmental liabilities. Report to title insurance company.

Union Camp Corporation, Franklin, VA, Lime Mud Pond:
Field investigation and analysis of hydrogeological conditions in vicinity of high-pH waste containment pond, in support of RCRA Part B permitting of the facility.

Montgomery County, MD, Travilah Quarry Hydrology:
Site assessment of suitability of existing quarry as a bale-fill (landfill accepting compressed, baled wastes). Supervision of water-balance field investigation and interpretation. Design flow for treatment facility.

KLNB Management Company, Columbia, MD, Fuel Oil Tank Leak:
Hydrologic assessment of oil migration. Design, construction, and operation of oil recovery system. Site assessment, preparation of corrective action plan (CAP) and associated permit applications, NPDES permit application, conceptual and final design, supervision, and startup of total fluids extraction and treatment system. Over 10,000 gallons of fuel oil escaped into the saprolite and shallow bedrock setting.

Cafritz Corp., Real Estate, Washington DC, Environmental Risk Assessment:
Assessment of potential liabilities assumed in purchase of a NY shopping mall with existing ground-water contamination.

Koppers Company, Carbondale, IL, Wood-Preservative Facility:
Evaluation of ground-water flow beneath site of historical creosote releases. Estimation of aquifer parameters using observed water levels and optimization procedures.

Gary R. Chirlin

Legal Counsel for Velsicol Corp., Hardeman County, TN:
Data analysis and development of ground-water models to reconstruct timing of past pesticide releases; in support of litigation.

Montgomery County, MD, Oaks Sanitary Landfill:
Performance and analysis of aquifer tests to evaluate two-aquifer system underlying landfill site. Design of a statistical "early-warning" ground water monitoring system to interpret water quality data.

United Nuclear Corp., Wyoming:
Development of an optimizing routine to estimate aquifer parameters from the results of pump tests involving multiple, interfering, variable-rate pumping wells and numerous observation wells.

Citizen's Group, Darnestown School, MD, Leaching Field:
Evaluation of the effects on local ground-water levels of a proposed sewage leaching field associated with a new development, using numerical modeling. The results of the study led to relocation of the development.

Water Supply and Water Rights

Montville Township, NJ, Water Supply:
Numerical model simulation of water supply development impacts in a glacial outwash aquifer.

New Mexico State Engineers Office, Water Rights Study:
Technical review of petitioner's claim on ground- and surface water rights in NM. Assessment of impact of ground-water withdrawals on stream flow using a quasi-3D numerical model of flow. Litigation support.

New Mexico State Engineers Office, Interstate Ground Water Transfer:
Numerical modeling to evaluate ground- and surface-water impact of proposed ground water withdrawals from Rio Grande's Mesilla Valley to supply El Paso, TX.

Tetra Tech, Intl., Salalah Plain, Oman, Salinity Intrusion:
Numerical modeling of saline wedge encroachment for various ground-water development management options.

Electric Utility, Western U.S., Water Rights Acquisition:
Feasibility study of ground water supply for conventional utility plant. Estimation of local streamflow reductions, and identification of required water rights purchases.

Town of Washington Grove, MD, Spring and Pond Hydrology:
Assess threat of proposed development to natural spring and ground water flow supplying the town recreational lake.

Gary R. Chirlin

New Windsor Community Action Project, Carroll County, MD, Quarry Permits Review:
Provide technical guidance and testimony during development of state surface mining, ground water appropriation, and surface discharge permits, and county zoning permit for a proposed marble quarry.

Electric Power Research Institute, Palo Alto, CA:
Develop a numerical model of the slug test, derive type curves for partial penetration, and assess limitations of the widely used Hvorslev (1951) and Cooper et al (1967) models.

APPENDIX B: List of Testimony of Gary R. Chirlin

APPENDIX B: List of Testimony of Gary R. Chirlin

Case Name	Court	Case Number	Trial(T),Deposition(D),Both(B)
US v. Charles George Trucking Company, Inc. et al.	US District Ct., Massachusetts	85-2463-WD	D
US and Dept of Environmental Resources vs Aluminum Company of America, et al. ("Moyer Landfill")	US District Ct., Eastern District of Pennsylvania	89-7421	D
US v. James L. Dickerson, Lareeta H. Dickerson, and Amtreco, Inc. ("Dickerson Post")	US District Ct., Middle District Georgia, Valdosta Div	84-76-VAL and 84-80-VAL	D
CF&I Fabricators of Utah, Inc., et al, Debtors. (CF&I Steel Corporation) ("Roebling Steel")	US Bankruptcy Ct., District of Utah, Central Div	90B-6721	T
US v. A&N Cleaners and Launderers, Inc., Ben Forcucci, Marine Midland Bank, N.A., Jordan W. Berkman, John A. Petrillo, Joseph Curto and Mario Curto ("Brewster Wellfield")	US District Ct., Southern District of New York	89 CIV. 6865 (RWS)	D
US v. Wheaton Industries ("Williams Property")	US District Ct., District of New Jersey	90-3880	B
US v. United Technologies Corporation ("Davis Liquids")	US District Ct., District of Rhode Island	90-0487-P	T
US v. Excel Corp., Durakool, Inc., and others ("Main Street Wellfield")	US District Ct., Northern District of Indiana	No. 3:93CV0119RM	D
US v. Scott's Liquid Gold, Inc. ("Rocky Mountain Arsenal")	US District Ct., District of Colorado	Civ. Action No. 94-B-2082	D
US v. Donald R. Lang, Wallis W. Smith, ARCO Chemical Co., Atlantic Richfield Co., Exxon Corp. and The Lubrizol Corp. ("Petro-Chemical Systems")	US District Ct., Eastern District of Texas	1:94-CV-57	D
US v. ConAgra, Inc. ("Armour Meat")	US District Ct., District of Idaho	CIV-96-0134-S-LMB	D

Borden Chemicals & Plastics Operating Limited Partnership v. Carol Browner as Admin. Of, and the US Environmental Protection Agency,
CONSOLIDATED WITH
US v. Borden Chemicals and Plastics Operating Limited Partnership;
Borden Chemicals and Plastics Management, Inc.
US District Ct., Middle District of Louisiana
Civ. Action No. 94-440-A-2 and
("Borden Chemical") Civ. Action No. 94-2592-A-M2 B

Scott's Liquid Gold-Inc. v. Travelers/Aetna Property, et al
US District Ct., Colorado
("Scott's Liquid Gold") Civ. Action No. 97-B-107 D

US and Dept. of Toxic Substances Control of the State of California v.
The Atchison, Topeka & Santa Fe Railway Co., et al.
US District Ct., Eastern District of California
("Brown & Bryant Pesticides") CV-F-92-5068 OWW B

US v. Colonial Pipeline Company
US District Ct., Northern District of Georgia
Civ. Action No. 1-00-CU-3142 D

US v. Pharmacia Corp. et al.
US District Ct., Southern District of Illinois, East St. Louis Div.
("Sauget Area 1") Civ. No. 99-63-DRH B

Appendix C. Publications of Gary R. Chirlin, 1994 to Present

Publications of Gary R. Chirlin, 1994 to Present

(none)

Appendix D. Compensation of Gary R. Chirlin

Chirlin & Associates is paid for Dr. Chirlin's time at an hourly rate of $180. Other direct costs are billed at cost without markup.